Feasibility of a Smartwatch and Smartphone Application to Remotely Monitor Patients with COPD

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Introduction

- ⇒ COPD exacerbations cause significant mortality and morbidity. Their early detection and prompt treatment may reduce these outcomes.
- ⇒ Currently, care of COPD patients is often reactive and requires patients to go to an emergency department for significant exacerbations.
- ⇒ Ideally, care would start in the home, prior to an exacerbation getting worse, before costly acute care services are needed
- ⇒ Early detection of acute exacerbations of COPD can occur through the use of mobile and wearable devices that sense patient parameters such as heart rate, respiratory rate, activity, and coughing.

Research Objective

- ⇒ To develop a mobile sensing device that will passively detect signs of early acute exacerbations of COPD

Materials

⇒ ***Smartwatch***

⇒ ***Smartphone***

⇒ ***wearCOPD***: A new smartphone application, developed at the University of Toronto by our research team, that senses and records physiological parameters, audio, and self-report questionnaires.

Procedure

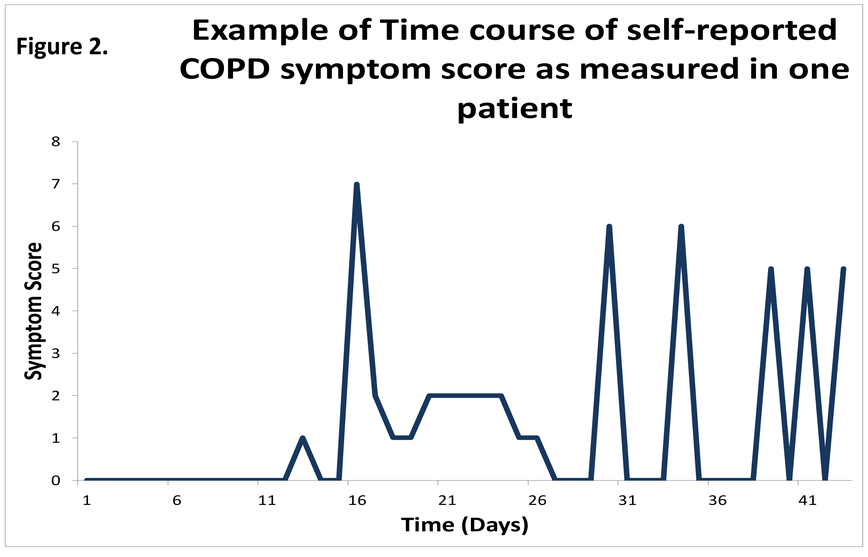
- ⇒ Patients with COPD recruited from **Sunnybrook Health Science Centre**, **Toronto General Hospital** and **Toronto Western Hospital**.
- ⇒ Provided with a smartwatch and smartphone with wearCOPD app
- ⇒ WearCOPD app records: **Physiological parameters** (heart rate, steps taken, movement, acceleration measures), **Audio** (to determine coughing, wheezing, shortness of breath) and a validated **daily measure of symptoms survey** (**Figure 1**)
- ⇒ Data collected each day is sent to a secure server each night.
- ⇒ Devices are retrieved after 90 days and patients asked to provide feedback.

Figure 1. Daily Self-Report Questionnaire

1. Did you experience any increased breathlessness?*
2. Did you experience any increased sputum colour?*
3. Did you experience any increased sputum amount?*
4. Do you have a cold?
5. Did you experience any increased wheeze or chest tightness?
6. Do you have a sore throat?
7. Do you have an increased cough?
8. Do you have a fever?
9. Are you in the Hospital?

***Major Symptom: scores 5 points (rather than 1 for minor symptoms)**

Figure 2.



Results

- ⇒ Three of 44 patients approached consented to participation. The main reasons for not participating were inconvenience and too sick to participate.
- ⇒ 173 hours, 34 minutes,of audio data was recorded over 48 days between Dec 23, 2015 and Feb 10, 2016.
- ⇒ A total of 2398 steps, 269050 heart rate sample files, and 74 self-report questionnaires were recorded. Summary results from one of the patient's self-report questionnaires can be seen on **Figure 2.**
- ⇒ Preliminary sound analysis was able to pick up episodes of coughing and throat clearing.

Conclusion and Future Work

- ⇒ Using smartphones and smartwatches to record physiological and audio data is a feasible way to monitor patients who suffer from COPD
- ⇒ Correlation of physiologic data to daily symptom score will be performed to validate its utility in identifying early acute exacerbations of COPD
- ⇒ The research team is extending recruitment to COPD patients from clinics, which is expected to increase participation.
- ⇒ Future plans to conduct a clinical trial to determine the effectiveness of COPDwear in detecting acute exacerbations of COPD in its early stages and its ability to allow for earlier intervention that prevents worsening disease. (see Figure 3, Phase 2)

Figure 3. Timeline of Future Goals